

MEMOIRS
OF THE
GEOLOGICAL SURVEY
OF
THE UNITED KINGDOM.

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*Figures and Descriptions*

ILLUSTRATIVE OF  
BRITISH ORGANIC REMAINS.

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DECADE V.  
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PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF HER MAJESTY'S TREASURY.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE:
PUBLISHED BY
LONGMAN, BROWN, GREEN, AND LONGMANS.
1856.

BRITISH FOSSILS.

DECADE THE FIFTH.

IN apologizing for the unavoidable delay which has taken place in the publication of this Decade, owing to the much lamented decease of Professor Edward Forbes, it is right to state that the materials left behind by him were scanty, and had been unfortunately mislaid a short time before his death. The first description only, that of *Solaster Moretonis*, had been fully written by him; of the others, we had here and there notes on the distinctive characters of the species, and of his views as to their synonymy or history. The plates, however, had been all engraved under his own eye, and the specific designations under which he wished the figures to stand, were recorded in the last edition of Morris's Catalogue. He had there also applied MS. names to a number of species to be described in the Decade.

In a few cases only it has been found necessary to alter some of these names; and this has been done in deference to an authority which would have been gladly admitted by Professor Forbes. To Mr. S. P. Woodward, of the British Museum, we are indebted for all the notes respecting these supplementary species; and he has also furnished full descriptions of three of the plates. With this valuable aid, and the friendly communications of Dr. T. Wright, of Cheltenham, we can present the Decade in nearly as complete a form as it would have possessed had our friend and Master lived to finish it. We miss, however, his lively remembrance of the living species, and his practical acquaintance with their variations,—deficiencies not to be supplied by reference to his published works.

Of the ten species figured three are new,—*Solaster Moretonis*, *Cidaris Carteri*, and *Pygaster conoideus*. Of the other genera, *Diadema*, *Echinopsis*, and *Echinus* present us with well-known types from the Oolitic rocks, which are continental as well as British. *Pyrina* is a rare genus in England, and in this, and the two figured species of *Pygaster*, we have excellent examples of that division of the *Cassidulidae* in which the ambulacra are of uniform character throughout. Several genera of this type have been figured in the Decades. The *Pygaster semisulcatus* is a critical species, and its synonymy is now for the first time cleared up. *Hemiaster Murchisonia* is another instance of the same kind, and belongs to a large genus of closely allied species. The *Brissus Scilla* is a Crag species still existing in the Mediterranean. None of these nine genera have before appeared in the Decades.

There are engraved plates sufficient for another fasciculus, upon which Professor Forbes left no memoranda, except the names of the species. These Plates will be published at a future period.

JOHN W. SALTER,
Palaeontologist.

Geological Survey Office, Jermyn Street, London,
February 1856.

APPENDIX TO DECADE V.

By S. P. WOODWARD, ESQ., BRITISH MUSEUM.

The Appendix contains descriptions of species referred to in the 2nd edit. Morris's Catalogue, for description in this Decade. To these one or two new species of the same genera are added, as also some additional species intended to be supplementary to descriptions in former Decades.

Genus CYPHOSOMA, Ag.—*Phymosoma* (D'Arch.), Desor.

1. *C. Königi*, Mantell (1822), Geol. Sussex, p. 189. *Cidarites variolaris*, Goldf., t. 40, f. 9 (not Brongn.) *Cyphosoma ornatissimum* (Ag.), Morris's Cat., 2nd ed., p. 75. *C. variolare*, Forbes, in Dixon, Fossils, p. x. pl. 25, f. 29. *C. Milleri* (Desm.), Forbes, in Dixon, p. 340, pl. 25, f. 26, 27. *Phymosoma Koenigii*, Desor, Synopsis, p. 86.

This species varies in diameter from less than an inch to two inches ; small examples are rare. The spines are short, straight, and round, contracting suddenly, and sometimes bent and angular near the point. Long spatulate spines also occur, associated with the normal test.

Mr. Bowerbank's cabinet contains a remarkable monstrosity of this species, which is inversely conical, like *Diadema tumidum*. It is 9 lines high, and 16 lines in diameter above, contracting below down to the oral opening, which appears at first to be the summit.

Locality.—UPPER CHALK, Kent, Sussex, Norfolk, Wiltshire, Yorkshire.

2. *C. granulosum* (*Cidarites*), Goldf., Petr. t. 40, f. 7. Desor, Syn. p. 87. Probably only a variety of the preceding species.

The primary tubercles are larger and more prominent ; the accessory tubercles are quite wanting in young specimens, and but slightly developed in the largest examples, which nearly equal the *C. Königi* in size. The base is flat, or slightly convex from the peristome outwards.

Locality.—Most abundant in the LOWER CHALK of Kent and Sussex.

3. *C. spatuliferum*, Forbes (1850), in Dixon's Geology of Sussex, p. 340, pl. 24, f. 21. (Coll. Mrs. Smith, of Tunbridge Wells.) *Cyphosoma* sp. (junior), Dixon, Sussex, tab. 24, f. 28-31.

Body small, circular, and rough with numerous small prominent tubercles ; lat. 10, alt. 4 lines ; areolæ plain above, radiated below ; base concave, mouth small, lat. 4 lines, apical opening pentagonal, irregular ; pores in single file ; ambulacral segments prominent, tubercles 8-10, largest at the circumference, with nearly confluent areolæ ; interambulacral

tubercles 9 in each row, bordered with very minute lateral tubercles, and divided by a conspicuous miliary furrow ; spines very much flattened.

Locality.—Rare in the UPPER CHALK of Kent and Sussex.

4. *C. tiara*, Ag., An. Sc. Nat., 1846, p. 351. Morris's Cat., 2nd ed., p. 75. *Cidaris tiara*, Hagenow. *Phymosoma saxatile*, Desor, Syn. p. 87.

"Nearly equally depressed above and below. A range of very inconspicuous secondary tubercles on the base, upon each side of the interambulacral areas, but disappearing at the circumference. Miliary tubercles very few. Pores reduplicate."—Desor.

This species was introduced into the English catalogues on the authority of M. Agassiz himself, but the specimen so named by Prof. Forbes appears to be only a casual variety of *C. Königi*. M. Desor's description answers best to *C. corollare*. He revives the name given to an urchin imbedded in flint, by Parkinson, who identified it with the living *Echinus saxatilis*. He also quotes Mantell's figure, which would be equally indeterminable, but that the specimen is preserved in the British Museum, and proves to be *C. spatuliferum*.

Locality.—UPPER CHALK, Gravesend, Kent.

5. *C. corollare* (Park.), Forbes, in Morris's Cat., 2nd ed., p. 75.

Body circular, depressed, lat. 12, alt. 4 lines (usually smaller), base concave, oral opening small (lat. 4 lines), apical opening large, pentangular (lat. $5-5\frac{1}{2}$ lines) ; pores crowded near the summit ; primary tubercles small, with plain areolæ ; interambulacral tubercles 9 in a row, with small irregular marginal and wide granular interspaces, becoming smooth above ; ambulacral tubercles 9-11, tapering to either end. Spines long, slender, and spatulate, one-fourth longer than the diameter of the test.

Locality.—Very common in the UPPER CHALK of Kent, and not unfrequently with the spines *in situ*.

6. *C. Wetherelli*, Forbes, in Morris's Cat., 2nd ed., p. 7.

Like *C. spatuliferum* ; but the interambulacral tubercles bordered by prominent miliary granules, and by small lateral tubercles on the under surface only.

The unique typical example, partly imbedded in flint, was obtained at Gravesend, and presented to the Museum of Practical Geology by N. T. Wetherell, Esq., F.R.S. In the absence of further evidence, it can only be considered a variety of the last species.

Locality.—UPPER CHALK, Gravesend.

7. *C. simplex*, Forbes, in Morris's Cat., 2nd ed. p. 77.

Body small, convex, lat. 9, alt. $4\frac{1}{2}$ lines ; base concave, mouth small ; apical opening pentangular ; primary tubercles prominent at the circumference, small and inconspicuous above ; areolæ radiated, large and nearly confluent at the middle, very small above, and separated by a wide finely

granulated miliary furrow; interambulacral tubercles 9, 10, with small laterals on the under surface; ambulacral tubercles 8, 8, with large confluent areolæ at the circumference. Pores in single file.

The test of this species is more highly ornamented than any of the preceding forms, but the upper surface appears nearly plain unless examined with a glass.

Locality.—Common in the hard gritty CHALK of Dover, and occasionally found in the CHALK with flints in Sussex.

8. *C. difficile*, Ag., Cat. Syst., p. 11. *Diadema rotatum*, and *D. M'Coyi*, Forbes, in Morris's Cat., 2nd ed., p. 76, 77. *Diadema rotulare*, M'Coy (not Ag.). *Glyphocyphus difficilis*, Desor, Syn., p. 104.

Body small, lat. 7, alt. 3 lines, convex above, slightly concave beneath; mouth circular, lat. $2\frac{1}{2}$ lines; apical disk equal to the oral opening, flat, finely granulated; ocular plates rather large, perforated close to the ambulacral margin; genital plates perforated (with a sur-anal plate in the centre?), and the madreporiform body on the right anterior plate; poriferous avenues nearly straight, distinct, with the pairs of pores in single series; tubercles prominent, quite smooth unless weathered, placed on crenulated bosses; ambulacra narrow, straight, with remote alternate tubercles irregularly developed, 3, 8, or 7, 8; interambulacrals in two straight rows of 8, 9, surrounded by small strongly radiated areolæ, and divided by deep sutural notches.

Small specimens, measuring 4 or 5 lines, are abundant, and usually overlooked as the young of the *Diademas*, but may be readily distinguished by the sutural notches. The more convex examples agree with the published mould of M. Agassiz's type specimen of *C. difficile*, but there is nothing in the description of *C. sulcatum*, Ag., to distinguish it from the same urchin. An unusually large specimen (in the cabinet of Mr. Sloper, of Devizes) measures 9 lines across and $4\frac{1}{2}$ in height; both rows of ambulacral tubercles are well developed, and the miliary granules form a prominent framework to the tubercles. Two specimens have occurred with the apical disk, one of which is in the Brit. Mus., and the other in Mr. Cunningham's Collection.

M. Desor refers this urchin to D'Archiac's *Glyphocyphus* (which was founded on the *Temnopleurus pulchellus* of Sornet, *Echinopsis pusilla*, Rømer, and incorrectly described as having the tubercles imperforate, and bosses not crenulate), but the structure of the apical disk is altogether different.

Locality.—CHALK MARL, Dover (Mus. Brit. and Tennant). UPPER GREEN SAND, Warminster.

9. *C. mespilia*, n. sp.

Body small, circular, inflated or depressed, convex above and below, with sub-equal apertures; lat. 5, alt. 3 lines; poriferous avenues quite

straight and simple, pairs of pores very oblique; tubercles minute, prominent, imperforated, and crenulated; areolæ small, radiated, with elongated miliary granules, sutures grooved; interambulacra with two rows of 7, 8 tubercles; ambulacra very narrow, with 7 or 8 tubercles, alternate and irregular.

Locality.—LOWER CHALK, Dover (Mus. Brit. and Bowerbank). This small but very distinct species has only been found in the hard WHITE CHALK, along with *C. simplex* and *Salenia granulosa*.

10. *C. Middletoni*, n. sp.

Body circular, tumid, concave beneath; lat. 10, alt. 6 lines; mouth small, depressed, lat. $3\frac{1}{2}$ lines; apical opening pentagonal, elongated, lat. $4-5\frac{1}{2}$ lines; pores in single file; primary tubercles small, in sub-equal rows of 12 each, the 6 uppermost minute; areolæ large at the circumference, nearly confluent; interambulacral tubercles bordered above by 6 nearly equal accessories, and divided by a broad furrow, smooth in the centre; secondary tubercles also developed on the base.

Locality.—UPPER CHALK, Norwich. This unique specimen was placed in the hands of Prof. Forbes, for description, by John Middleton, Esq., of Norwich.

SALENIA, Gray.

In the 2nd edition of Prof. Morris's Catalogue of British Fossils, p. 89, the following species of *Salenia* are referred to, as described by Prof. Forbes in Decade V. No MS. having been left, the following notes are drawn up from the type specimens in the Museum of Practical Geology.

1. *Salenia Austeni*, Lower Chalk, Dover.
2. *S. Bunburyi*, Lower Chalk, Mildenhall.
3. *S. Clarkii*, Lower Chalk, Dover.
4. *S. clathrata* (Ag. MS.), Upper Green Sand, Warminster.
5. *S. granulosa*, Lower Chalk, Dover.
6. *S. Portlockii*, Upper Chalk, Ireland.
7. *S. umbrella* (Ag. MS.), Upper Green Sand, Warminster.
8. *S. ornata* (Ag. MS.), Upper Green Sand, Warminster (Decade I. 5, p. 2).

1. *S. Austeni*, Forbes, MS. Like *S. petalifera*, Desm.

Body tumid, depressed, lat. 10, alt. 6 lines; apical disk comparatively small, 5 lines in diameter; the plates ornamented with serrated ridges running in pairs from their centres, and meeting to form a sort of trellis.

Two of the original specimens, in the Museum of Practical Geology, are more distinct from *S. petalifera* than any other examples. The apical disk of *S. petalifera* is very finely granulated, but, as remarked by Prof. Forbes (Decade I. 5, p. 3), "a few rare specimens exhibit indistinct indications of radiated ribbing." In the Grey Chalk of Dover, some examples are nearly plain, others

highly ornamented, but never two alike. The sutural pores appear more numerous in the sculptured specimens, there being 5 to each ocular plate.

Locality.—LOWER (or GREY) CHALK of Dover.

2. *S. Clarkii*, Forbes, MS.

Body 6 lines in diameter, 4 in height; apical disk rather small, scarcely exceeding 3 lines in diameter, the plates rough, with raised points; each genital plate with five furrows leading to the sutural pores, which are like those of *S. petalifera*, but larger; ambulacra rather narrower than in *S. petalifera*; spines slender, cylindrical, finely striated and granulated, the longest exceeding $1\frac{3}{4}$ inches in length, and less than 1 line in diameter, frequently forked at their extremities, and sometimes bent and distorted.

This species is scarcely to be distinguished from those Warminster specimens which have been referred to *S. gibba*, Ag.; but is entirely distinct from the *mould* of M. Agassiz's original example.

Locality.—GREY CHALK, DOVER. (Mus. Pract. Geol. and Brit. Mus.)

3. *S. granulosa*, Forbes, MS. Morris's Cat., 2nd ed. p. 89. *S. scutigera*? Forbes, in Dixon's Geol. Sussex, t. 25, f. 24.

Body small, lat. 6, alt. $3\frac{1}{2}$ mill.,—sometimes it measures only $1\frac{1}{2}$ lines in diameter; oral opening large, not depressed; apical disk very large, lat. $4\frac{1}{2}$ lines, plates finely sculptured with rugose lines, sometimes radiated, sutures quite simple; primary tubercles few and prominent; miliary zone irregular, granulose; ambulacra narrow.

Locality.—LOWER CHALK, DOVER. Found along with *Cyphosoma simplex* and numerous *Bryozoa*, in the hard gritty beds of White Chalk. (Mus. Pract. Geol., Brit. Mus.)

4. *S. Portlockii*, Forbes, MS. Morris's Cat., 2nd ed., p. 89. *Cidaris vesiculosus*, Portl., Geol. Rep., t. 18, f. 5. *S. scutigera*? Forbes, Dixon's Sussex, pl. 25, f. 23. *S. geometrica*, Ag., Mon. d'Ech. Salenies, p. 11, t. 1, f. 25-32.

Body subglobose, elevated, convex above, contracted and concave beneath, lat. 9, alt. 8 lines; mouth small, lat. 3 lines; apical disk moderate, lat. 6 lines; plates slightly radiate; sutural perforations rather indented; ambulacra narrow, sinuous, tubercles separated by two rows of granules; interambulacral tubercles 7-8, those near the mouth (3, 4) very small; miliary zone wide.

The specimen described belongs to Mr. Searles Wood; another, in the cabinet of Mr. John King, of Norwich, measures 11 lines in height, and the same in diameter; and there is a fine specimen in the Hunterian Collection. The agreement of this species with *S. geometrica* has been overlooked on account of an error in

the figure given by M. Agassiz; the published *mould* is quite like our fossil:—"L'espace entre les deux séries de gros tubercles est parsemé, comme dans l'espèce précédente (*S. petalifera*), mais en nombre moins considerable, de très-petites granulations, qui ont été omises par erreur dans le dessin."

The *Cidaris acrocidaris*, Portl., from the Irish Chalk, is a flint cast of a small *Salenia* resembling that figured in Dixon's Geology of Sussex, pl. 25, f. 25. It may be the cast of one of the un-named species (of which there are several in the British Museum) found in Scania and at Ciplý.

Locality.—This beautiful species occurs in the CHALK of the North of Ireland, and, very rarely, in the UPPER BEDS OF CHALK at Norwich, and in Sussex. It is also found at Havre. *Flint casts* are not uncommon in the gravel of Norfolk.

5. *S. clathrata*, Ag., MS. Morris's Cat., 2nd ed., p. 89.

Body subglobose, very convex above; lat. 6, alt. $4\frac{1}{2}$ lines; apical disk lat. $5\frac{1}{2}$ lines, nearly covering the upper surface, its outline very deeply indented between the ocular and genital plates; anal opening with a very prominent margin; plates smooth, deeply notched at the sutures, those connecting the centres of the plates forming a distinct pentagon, and each of the genital pores is the centre of five radiating grooves, with angular pits between; ambulacra narrow; tubercles few and prominent, separated by a narrow miliary zone.

The smallest specimens found at Warminster are very gibbous, and appear to be dwarfs, rather than young individuals. The species attains a large size in the Grey Chalk, and are occasionally more depressed, with the marginal lobes of the anal disk broader, and the sutural grooves less excavated. The name *S. umbrella* (Ag., MS.) appears to have been intended for those specimens with the sutural grooves most deeply and sharply defined. The figure in Parkinson's Organic Remains (vol. iii. pl. 1, f. 13), referred to by Prof. Forbes, in Decade I., as "*S. ornata*, Ag. MS.," is indeterminate.

Locality.—UPPER GREEN SAND, Warminster; GREY CHALK, Dover.

6. *S. Bunburyi*, Forbes, MS. Morris's Cat., 2nd ed., p. 89.

Body subglobose, tumid above, with a wide base, and depressed oral aperture; lat. 7, alt. $5\frac{1}{2}$ lines; apical disk, $5\frac{1}{2}$ lines in diameter, vent with a prominent thickened border, plates sculptured at the border of the disk, sutural notches forming deep linear grooves (as in *S. umbrella*); ambulacra narrow, sinuous, with small remote tubercles divided by a prominent granulated ridge; interambulacral tubercles 4, 5, prominent, divided by a wide miliary tract.

Locality.—LOWER CHALK, Mildenhall, near Bury St. Edmunds. The original and unique specimen in the Mus. Pract. Geol. was presented by E. H. Bunbury, Esq., M.P.

7. *S. punctata*, Desor.

This is the only British species belonging to the section *Peltastes*, Ag., in which the sur-anal plate is placed between the vent and the odd ambulacrum; a specimen in the late Dr. Mantell's Collection has the vent situated as in the normal *Salenias*.

Locality.—GREEN SAND, Farringdon. The specimen from the Kentish Rag of Hythe, presented to the Mus. Pract. Geol. by H. B. Mackeson, Esq., differs in no respect from Farringdon specimens of the same size.

Cardiaster grandis, Benett. sp., *Spatangus grandis*, Benett (1831), Cat. Org. Rem. Co. Wilts, p. 7. (S. Woodward, 1835. Monograph of Brit. Fossil Echinidæ. MSS. in Mus. Pract. Geol.)

Oblong, cordiform, inflated; vertex moderately elevated, anterior sulcus rather deep; lateral ambulacra not impressed, pores symmetrical; primary tubercles regularly distributed and equal in size above the lateral fascioles, rather more crowded below, and larger on the under surface; the upper is densely covered with miliary granules, leaving annular spaces round the tubercles; post-oral spaces elongated, covered with rather larger tubercles, surrounded and divided by single rings of granules. Lon. $3\frac{1}{4}$; lat. $2\frac{3}{4}$; alt. 2 unc.

Locality.—UPPER CHALK, Norwich (Coll. J. King). "Chalk and Flint, Heytesbury, Wilts." (Mus. Benett; Brit. Mus.)

Cardiaster Cotteauanus, D'Orb., Ter. Cret., pl. 830.

Locality.—Mr. Baily has recognized the occurrence of this species in the UPPER CHALK of Kent. There are two specimens from Dover in the Museum of Pract. Geol., and one considerably smaller, and somewhat different, from the UPPER GREEN SAND of Warminster, in the British Museum.

Epiaster crassissimus, D'Orb., Ter. Cret., pl. 860.

A specimen in the Mus. Pract. Geol., from the hard GREY CHALK of Dover, only differs from D'Orbigny's figure in being more depressed. Another species, from the UPPER CHALK of Dover, in the Brit. Museum, has extremely small and scarcely impressed ambulacral petals; the surface is perfectly preserved, but exhibits no fascioles.

Micraster Mantelli, Forbes, MS. Morris's Cat., 2nd ed., p. 83.

The specimens with this name attached do not differ in any respect from those recognized as the young of *M. cor-anguinum*; at this age they are always very tumid, and the dorsal ambulacra are scarcely at all impressed.

Locality.—UPPER CHALK of Dover and Kent.

S. P. WOODWARD.